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could be obtained to show absorption at three of the principal series lines, but the glass tube collapsed before any further result could be obtained. It is hoped that more success may be obtained with a quartz or silica tube.

The author feels much pleasure in expressing his thanks to the Government Grant Committee of the Royal Society for a grant to purchase the quartz spectrograph which was used for the purposes of this research.

On a Novel Phenomenon in the Diurnal Inequality of Terrestrial Magnetism at certain Stations.

By Robert B. Sangster.

(Communicated by Dr. C. Chree, F.R.S. Revised MS. received January 11,—Read February 10, 1910.)

In this research the author dealt with data from the Magnetic Observatories at Greenwich, Falmouth, and Pawlowsk (Russia). The declination, the horizontal, and the vertical, forces of terrestrial magnetism are denoted by D, H, and Z respectively, and the horizontal force in the astronomical meridian by X. Diurnal inequality increments are designated by the prefix Δ. The formula for obtaining ΔX is

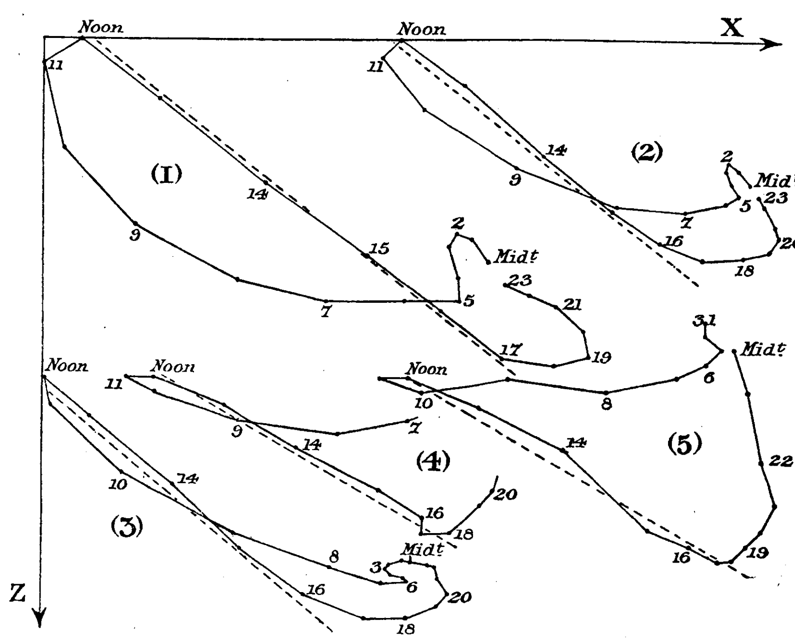
$$\Delta H \cos D - H\Delta D \sin D = \Delta X,$$

and the unit of force employed is 1×10^{-5} C.G.S. ($1\,\gamma$).

The factor for conversion of ΔD from minutes of arc to units of $\gamma\,(H\Delta D)$ is $H \sin 1'$; hours are counted continuously from midnight to midnight, and in the attached diagrams the scale value employed is 1·85 mm. $= 1\,\gamma$.

The research ultimately proceeded on the principle of the vector diagram. The latter has usually been employed to display variations of the horizontal component, but in this case the author uses values of ΔX and ΔZ, and so obtains a representation of the diurnal force changes as projected on the vertical plane containing the astronomical meridian. Curves showing the force variations in this plane may be designated XZ diagrams. The X axis being taken as positive to the right and an increase of Z as downwards, the resulting curve has to be regarded as being viewed from the east. The feature in these diagrams to which special attention is drawn is the agreement in the trend during the early afternoon hours with a line drawn at an angle of dip equal to the colatitude of the place of observation, and so perpendicular to the Earth's axis. For the hours from noon to about 17 the curves show that there is little or no variation in the force component parallel to the Earth's axis.

The magnetic diurnal inequality observed at Greenwich during the epoch 1900–06 was more particularly dealt with. The hourly values of ΔD, ΔH, and ΔZ, for "all" days of the Junes and Julys (midsummer) during the epoch were extracted from Table II, and from the temperature-corrected columns of Tables V and IX of the "Greenwich Magnetical and Meteorological Observations" for the several years. The arithmetic mean value at each hour was found and converted into units of γ, and the values of ΔX were determined and tabulated along with those of ΔZ.



The result for midsummer is shown graphically in the diagram (1). The interrupted line makes an angle with the X axis equal to the colatitude of Greenwich (tan colatitude, 38° 32′ = 0·7964), and, therefore, represents a direction perpendicular to the Earth's axis. It will be seen that the hours noon to 17 are closely collateral with the interrupted line, thus indicating that during these hours there was practically no variation in the component parallel to the Earth's axis.

Diagram (2) is a similar representation of the diurnal inequality at Greenwich for "all" days of the epoch 1900–06, the values of $H\Delta D$, ΔH, and ΔZ being obtained from the last three columns of the Greenwich Tables XII. The diagram (2) has the appearance of resulting from a double oscillation in the component perpendicular to the Earth's axis, while the variation in the component parallel to the axis is mainly in evidence near the turning points of this double oscillation. The time noon to hour 16 is, however, the period when variation of the latter component is least in evidence, and the same feature was found to exist in all the other examples of XZ diagrams made from Greenwich data for the same epoch. These included the mean of all the "quiet" days, the mean of the seven examples of each month of the year, both for "all" and for "quiet" days, and results for the single year 1904 and the single month of June, 1904, these last for special consideration and comparison with XZ diagrams for the same epochs at Falmouth and Pawlowsk. The values of ΔX and ΔZ for "quiet" days were corrected for non-cyclic increment in the usual way by the addition of $(12-t)\,I/24$, where I is the increment in the 24 hours and t the number of hours elapsed since midnight. The XZ diagrams of "quiet" day means showed a recognisable difference of type from those of "all" days, particularly in the nearer approach to parallelism in the trend of the forenoon to that of the afternoon hours, while the main feature of little or no change in the component parallel to the Earth's axis during the afternoon hours was equally well maintained. The winter months invariably showed a shorter duration of the latter feature, while, in general, a larger diurnal range produced a more exact and lengthened exhibition of the phenomenon.

Similar results were obtained from the "quiet" day observations at Falmouth Observatory. Diagram (3) is the XZ curve of the mean of all the "quiet" days observed there during the epoch 1903–07, and the interrupted line shows the corresponding direction of a perpendicular on the Earth's axis. The mean "quiet" day of the six summer months during the same epoch, and the mean of the "quiet" days in the year 1904 and in the month of June, 1904, were likewise dealt with, and it was found that the XZ diagrams for these also showed the existence of the phenomenon.

The author notes that all his Greenwich diagrams are nearly square-ended between hour 11 and noon, while those drawn from Falmouth data have the corresponding end more acute. This feature almost serves to locate the origin of the data as between the two stations, and is due to the employment of G.M.T. at Falmouth.

Diagram (4) is part of the HZ curve for "all" days of the year 1904 at Pawlowsk. The mean declination was 55′·07 east, so that ΔH values approximate very closely to those of ΔX. The dip of the interrupted line equals the colatitude of Pawlowsk (tan colat. $30^\circ\,19' = 0{\cdot}5847$). The feature of little change in the component parallel to the Earth's axis during the hours noon to 18 is well shown here. There is little other likeness to Greenwich or Falmouth types of XZ diagrams.

The mean of data from Pawlowsk for the five "quiet" days in June, 1904, selected by the Astronomer Royal, also showed the existence of the phenomenon. Diagram (5) is drawn from the mean ΔH, ΔZ, observed on "all" days at Pawlowsk during the epoch 1873–85. The mean trend during the early afternoon hours agrees in direction with the interrupted line, and although some of these hours show a pretty large departure, they are undoubtedly the period of the day when the component parallel to the Earth's axis exhibits least change.

It may be stated that the existence of the phenomenon just described was inferred from a working hypothesis of the cause of the diurnal inequality, but the terms of this have not, as yet, been sufficiently defined to justify its publication.

In conclusion, the author has pleasure in acknowledging his indebtedness to Dr. Charles Chree, F.R.S., for kind advice on numerous technical points, and for supplying data not otherwise easily obtainable.